Nitrous oxide and day-case laparoscopy: effects on nausea, vomiting and return to normal activity

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Abstract: Patients admitted for day-case laparoscopy were assigned randomly to receive nitrous oxide-oxygen or oxygen, with enflurane, during a standard anaesthetic technique. Postoperative morbidity, in particular nausea and vomiting, and ability to resume normal activity were assessed over the ensuing 48 h. Supplementary administration of propofol during the operative procedure was required significantly more often (P less than 0.05) in the absence of nitrous oxide. There was no significant difference in the incidence of vomiting before discharge when nitrous oxide was omitted. The incidence and severity of nausea over the 48 h following operation was similar in both groups. There was no difference in analgesic or anti-emetic requirements before discharge and the time taken to resume normal activity was similar. It is concluded that nitrous oxide may be avoided readily in day-case laparoscopy without affecting postoperative morbidity or time taken to return to "street fitness" and normal activity.

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NITROUS OXIDE AND DAY-CASE LAPAROSCOPY: EFFECTS ON NAUSEA, VOMITING AND RETURN TO NORMAL ACTIVITY

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SUMMARY

Patients admitted for day-case laparoscopy were assigned randomly to receive nitrous oxide–oxygen or oxygen, with enflurane, during a standard anaesthetic technique. Postoperative morbidity, in particular nausea and vomiting, and ability to resume normal activity were assessed over the ensuing 48 h. Supplementary administration of propofol during the operative procedure was required significantly more often ($P < 0.05$) in the absence of nitrous oxide. There was no significant difference in the incidence of vomiting before discharge when nitrous oxide was omitted. The incidence and severity of nausea over the 48 h following operation was similar in both groups. There was no difference in analgesic or anti-emetic requirements before discharge and the time taken to resume normal activity was similar. It is concluded that nitrous oxide may be avoided readily in day-case laparoscopy without affecting postoperative morbidity or time taken to return to "street fitness" and normal activity.

Alexander and colleagues [1] found that nitrous oxide appears to reduce the frequency of postoperative nausea and vomiting after gynaecological laparoscopy, although the duration of effect was not documented. Lonie and Harper [2] found also, in patients undergoing laparoscopy, a significantly reduced incidence of postoperative vomiting, still evident the day after operation, when nitrous oxide was omitted from the anaesthetic technique, but there was no difference in the incidence of nausea. The frequency of nausea and vomiting after day-case laparoscopy may exceed 80% [3] and might affect the patient's ability to resume normal activity. This study was designed to assess primarily the effect of nitrous oxide on nausea and vomiting and subsequent return to normal activity after day-case laparoscopy.

PATIENTS AND METHODS

Eighty unpremedicated patients older than 18 yr and ASA status I/II were assigned randomly to receive nitrous oxide–oxygen or oxygen as part of a standard anaesthetic technique for day-case laparoscopy. Patients with a history of excessive nausea and vomiting after previous anaesthetics were excluded.

All anaesthetics were administered by the authors. The patients were given fentanyl 1.5 μg kg^{-1} i.v. and anaesthesia was induced with propofol 2 mg kg^{-1} i.v. followed by vecuronium 0.06 mg kg^{-1} i.v. Propofol was chosen because of its short elimination half-life (35–60 min), having been shown to be superior as an induction agent to both methohexitone and thiopentone with respect to immediate postoperative recovery in day-case surgery [4]. The patient's lungs were ventilated manually using a Guedel airway for 2 min before tracheal intubation, which was accomplished after the vocal cords had been sprayed with 4% lignocaine; one group received an inspired gas mixture of 33% nitrous oxide and 1% enflurane in oxygen, and the other 2% enflurane in oxygen. Thereafter ventilation was maintained with a Bain system and a Nuffield Penlon ventilator. The Bain system was arranged with a side-arm through which metered air from a cylinder could be mixed with the gases emerging from the outlet of the Boyle's machine. A Critikon

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Oxychek oxygen analyser was sited distal to the air inlet and a Hewlett–Packard 47210A capnometer was used to measure end-tidal carbon dioxide concentrations. The ECG was monitored by Cardiorator CR5 on standard lead 2 and the heart rate recorded at 5-min intervals. The incidence and type of any arrhythmias were noted. Arterial pressure was measured at 5-min intervals using an Accutorr ultrasonic recorder, and an Engstrom Emma analyser was used to monitor end-tidal enflurane concentration.

In theatre, the inspired enflurane concentration was adjusted to give the group receiving nitrous oxide an end-tidal concentration of 0.75% and the second group an end-tidal concentration of 1.5%. In the group not receiving nitrous oxide, ventilation was maintained with 40% oxygen-enriched air using a fresh gas flow of 70 ml kg^{-1}, a frequency of 12 b.p.m. and a tidal volume adjusted to maintain the end-tidal carbon dioxide concentration within the normal range. Movements by the patient during laparoscopy, lachrymation, sweating and a heart rate greater than 100 beat min^{-1} or a systolic arterial pressure greater than 20 mm Hg in excess of the preoperative value recorded on two consecutive occasions were criteria for giving increments of propofol.

All laparoscopies were performed by the same operator. Approximately 2 litre of carbon dioxide was used to insufflate the peritoneum. Sterilizations were excluded from the study. At the end of the procedure attempts were made to remove as much carbon dioxide from the peritoneal cavity as possible and neuromuscular block was antagonized with atropine 1.2 mg and neostigmine 2.5 mg i.v. Pharyngeal suction was carried out before tracheal extubation if possible, and the airway removed immediately thereafter.

Patients were transferred to a recovery area and prescribed paracetamol 500 mg by mouth 4-hourly as required for pain and metoclopramide 10 mg i.m. as required for nausea and vomiting. I.m. pethidine was available if necessary for severe pain. The incidence and frequency of vomiting and administration of analgesic and antiemetic drugs were recorded. Patients were asked to grade nausea and abdominal pain as nil, mild, moderate or severe 30 min after admission to recovery and every 1 h thereafter until discharge, which occurred when the patient was considered to be "street fit" (when they were alert and orientated, with stable recordings of heart rate and arterial pressure, and able to ambulate normally, unaided).

On discharge patients were given a questionnaire to be completed at 24 and 48 h after operation. Nausea, abdominal pain and backache were graded as absent, mild, moderate or severe and appetite was graded as absent, below normal or normal. Inquiries as to abdominal pain were included because of possible association with emetic symptoms and those as to backache and tiredness so that patients' attention would not be focused unduly on nausea and vomiting.

Statistical analysis was performed by Chi-square with Yates' correction.

RESULTS

We studied 80 patients, of whom 64 (80%) (33 in the nitrous oxide group and 31 in the second group) returned questionnaires; analysis was undertaken, therefore, on 64 patients. There were no significant differences between the groups in age, weight, duration of anaesthesia or surgery (table I). There was a small number of arrhythmias, but arterial pressure and heart rate remained stable throughout the procedure in both groups. In the nitrous oxide group, three patients developed bradycardia requiring atropine and two developed a nodal rhythm which did not require treatment. In the group not receiving nitrous oxide, two patients developed bradycardia requiring atropine and two had nodal rhythms which did not require treatment. Supplementary bolus injections of propofol were administered

TABLE I. *Age, weight and duration of anaesthesia, surgery and stay in the recovery room before discharge in patients receiving either nitrous oxide–oxygen or oxygen. Mean values (range)*

	Nitrous oxide	Without nitrous oxide
Age (yr)	31.13 (18–41)	31.32 (22–61)
Weight (kg)	60.88 (37.2–80.7)	61.62 (47.2–83.0)
Duration of anaesthesia (min)	23.87 (16–44)	22.10 (16–33)
Duration of surgery (min)	14.83 (9–26)	14.64 (10–26)
Duration of stay in recovery (h)	3.6 (2–6)	3.4 (2–6)

TABLE II. *Postoperative morbidity and administration of analgesic and anti-emetic drugs before discharge (number of patients per group). No significant difference between groups*

		Nitrous oxide	No nitrous oxide
Nausea	Severe	5	3
	Moderate	7	7
	Mild	5	4
	Total	17	14
	Nil	16	17
Vomiting	> 2	0	0
	× 2	5	1
	× 1	6	3
	Total	11	4
	0	22	27
Abdominal pain	Severe	4	7
	Moderate	21	12
	Mild	6	10
	Total	31	29
	Nil	2	2
Analgesia	I.m.	2	2
	Oral	27	19
	Nil	4	10
Anti-emetic		13	10
Awareness		0	1

toward the end of the procedure in eight patients (26%) not receiving nitrous oxide to prevent slight movements, compared with one (3%) in the nitrous oxide group ($P < 0.5$).

One patient only, who did not receive nitrous oxide, complained of awareness. This patient remembered hearing voices for a short period during laparoscopy but, on direct questioning afterwards, did not complain of any discomfort or regard the experience as distressing. There were no significant differences after operation in the incidence or severity of nausea, vomiting or abdominal pain. Frequency of administration of anti-emetics and oral analgesics were similar (table II).

Analysis of the returned questionnaires revealed no significant differences in emetic symptoms. At 24 h after operation 51.5% complained of nausea and 18% complained of vomiting in the nitrous oxide group, compared with 38.7% and 9.7%, respectively, in the second group. At 48 h the frequencies were 30.3% for nausea and 9.1% for vomiting in the nitrous oxide group, compared with 25.8% and 0%, respectively, in the second group. Abdominal pain, backache, appetite and time taken to resume normal activity were similar in both groups over the 48 h following discharge.

DISCUSSION

The omission of nitrous oxide from an anaesthetic technique has been reported to reduce emetic symptoms following in-patient gynaecological laparoscopy [1, 2]. The emetic effect of nitrous oxide may result from opioid receptor agonism [5–7], pressure effects in closed body cavities, or both. Studies have shown that the incidence of nausea after day-case laparoscopy varies between 36 and 82% during immediate postoperative recovery [3, 8], approaches 28% 24 h after discharge [8, 9] and 11% 48 h after discharge [9]. The incidence of vomiting before discharge is reported to vary between 11 and 49% [2, 10].

Our results are consistent with these data, but we found that the use of nitrous oxide did not increase the frequency of emetic sequelae. These findings are not so unequivocal as those of Alexander, Skupski and Brown [1] who demonstrated a significant reduction in both nausea and vomiting on omission of nitrous oxide, but tend to support the results of Lonie and Harper [2]. However, although our study has not demonstrated a statistically significant difference in the incidence of postoperative vomiting, 33% of the nitrous oxide group vomited compared with 12.9% of the second group in the immediate postoperative period. If this trend were to persist, sample sizes of approximately 100 patients per group would have been necessary to have sufficient power to produce a statistically significant result at the 0.05% level.

Previous experience in our unit has shown that, with 67% nitrous oxide and fentanyl 1.5 $\mu g\ kg^{-1}$ i.v., 0.75% enflurane provides good anaesthetic conditions for day-case laparoscopy. During induction, higher concentrations of enflurane were used in both groups to prevent possible awareness during this vulnerable period. Nitrous oxide reduces MAC for enflurane by approximately 60%. When it was omitted for simplicity, the enflurane concentration was doubled. However, the total MAC for the group not receiving nitrous oxide was therefore slightly less than for the nitrous oxide group, which might explain the significantly greater use of bolus injections of propofol in the former group and the single case of awareness (table II). Nonetheless, the case of awareness and the 26% incidence of movement when nitrous oxide was omitted suggests that nitrous oxide may confer some advantages for the production of smoother anaesthesia and thereby

compensates for its tendency to increase postoperative emetic symptoms, especially as these do not seem to delay discharge and resumption of normal activity. Use of slightly greater concentrations of enflurane during laparoscopy, when nitrous oxide is omitted, should reduce the incidence of awareness and movement. The absence of effect on discharge time is supported by other studies [11].

Although linked to postoperative emetic symptoms, appetite is also an indicator of general well-being and was included in the questionnaire to detect any subtle differences between the groups. However, no differences were observed between the two groups.

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